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XV. *On the Marsupial Pouches, Mammary Glands, and Mammary Fœtus of the Echidna Hystrix.* By Professor OWEN, F.R.S., &c.

Received February 18,—Read March 2, 1865.

IN the year 1834\* it was known that the ovum of the *Ornithorhynchus paradoxus* left the ovarium with a spherical yelk or vitellus about  $1\frac{1}{2}'''$  (lines) in diameter, and that, having reached the uterine portion of the oviduct, it had acquired a smooth subtransparent chorion or outer tunic separated from the proper membrana vitelli by a clear fluid. Such ova, usually two in number, had been detected in females killed in the month of October, in the left uterus, of sizes ranging from  $2\frac{1}{2}'''$  to  $3\frac{1}{2}'''$  (lines) in diameter, without any sign of organization of the chorion, or of preparation for placental adhesion on the uterine wall.

The increase of size in the uterine over the ripe ovarian ovum was due to increase of fluid between the chorion and vitelline tunics.

This fluid, homologous with the albumen of the egg of oviparous vertebrates, did not coagulate in alcohol, and the only change presented by the vitellus of the largest observed ovum was a separation from the “food-yelk” of a “germ-yelk” in the form of a stratum of very minute granules, adhering to part of the membrana vitelli. There was no trace of decidua in such impregnated uteri; the smooth chorion was firmer than that of uterine ova of *Rodentia*; whence, and for other reasons given in the paper above cited, it was inferred “that the *Monotremata* are essentially ovo-viviparous.”

In the same year (1834) I received a young of the *Ornithorhynchus paradoxus* from a nest of that animal, discovered by Lieut. the Hon. LAUDERDALE MAULE in the banks of the “Fish River,” Australia. This progeny, Plate XLI. fig. 5, measured in a straight line about 2 inches (other admeasurements will be subsequently given); it was naked, blind, with short, broad, flexible, and softly labiate mandibles; the tongue was proportionally large, and reached to near the end of the mandibles; the mouth was not round, as in the mammary fœtus of marsupials, but in the form of a wide transverse slit; a pair of small nostrils (*a*) opened upon the upper mandible, and between them was a small prominence (*e*), resembling the knob on the beak of the newly-hatched chick, but softer, and lacking the cuticle which had been torn off. There was no trace of navel or umbilical cicatrix†. The mouth of this young Platypus, or *Ornithorhynchus*, was adapted to be applied to the flat teatless areola upon which the numerous lactiferous ducts of the parent opened‡.

\* “On the Ova of the *Ornithorhynchus paradoxus*,” Philosophical Transactions, vol. cxxiv. p. 555.

† “On the Young of the *Ornithorhynchus paradoxus*,” Zoological Transactions, vol. i. p. 221.

‡ “On the Mammary Glands of the *Ornithorhynchus paradoxus*,” Philosophical Transactions, vol. cxxii. p. 517.

and it was inferred that thus it received the lacteal nourishment with the aid of the compressor muscle of the large mammary gland.

The principal points in the generation of the *Monotremata* which remained to be determined by actual observation were—

- 1st. The manner of copulation.
- 2nd. The period of gestation.
- 3rd. The nature and succession of the temporary structures developed for the support of the foetus during gestation.
- 4th. The exact size, condition, and powers of the young at the time of birth.
- 5th. The period during which the young requires the lacteal nourishment.
- 6th. The age at which the animal attains its full size.

“Notes” of these desired facts, with indications of the times and places most likely to supply them, have been sent by me far and wide, through Australia and Tasmania; and after the lapse of thirty years, I have been favoured with materials for making some further advance in this interesting physiological problem—a small one, it is true, but such as seemed to me worthy of being submitted to the Society as an addition to former records on the subject contained in the Philosophical Transactions.

For these materials I am indebted to my friend the accomplished botanist, Dr. FERDINAND MUELLER, F.R.S., of Melbourne, Australia. They consist of a female *Echidna* (*Ornithorhynchus Hystrix* of Home, *Echidna Hystrix* of Cuvier, the “Porcupine Anteater” of the colonists) and her young one, or one of her young, which was observed, as the captor supposed, suspended to a nipple when the animal was first secured. After five days’ confinement the young was found detached and dead, was put into a bottle of spirits, and, with the mother still living, was transmitted from “Colac Forest,” Victoria, the place of capture, to Melbourne. Here the female *Echidna* was examined by Dr. MUELLER and Dr. RUDALL of Melbourne, and was then transmitted to me, together with the young animal, and the following “Notes” of their dissection.

“*Brief Notes on the Generative Apparatus of the female Echidna.*”

“The animal being excessively difficult to handle it was immersed in cold water, and by these means and the additional use of hydrocyanic acid its life was extinguished. A longitudinal incision was made from the orifice of the cloaca upwards to the length of about 5 inches. Five larger and some smaller ovules were found arranged in a grape-like manner, the largest measuring from  $1'''$  to  $1\frac{1}{2}'''$  [lines] “in diameter. Fine vessels expanded reticularly over the surface of the ovules. We vainly endeavoured to trace an opening at the ovarian end of the oviduct. Oviduct about  $2''$  [inches] “long; its upper extremity expanded and attached to the ovarium. As a probable sign of recent functional activity, were noted a number of large distended veins lying between the layers of the peritoneum. Numerous oval mesenteric glands were seen. ‘Meatus urinarius’ lying in the inferior wall of the cloaca about  $\frac{1}{2}''$  from the orifice. The ureter terminates in a conspicuous conical protuberance from  $3'''$  to  $4'''$  long. No other exit for the urine from the

bladder being found but the point into which this conical protuberance fits, the ingress and egress of the urine, as far as we believe, takes place at the same aperture. In close proximity, and lateral to it, the oviducts terminate by slit-like openings. The mucous membrane of the thick walls of the oviducts are, at least in the lower portion, longitudinally folded. The oviducts are suddenly narrowed for about  $\frac{1}{6}$ " from the lower orifice, offering some resistance to the passage of an ordinary sized probe.

"The upper portion of the oviduct seems of a structure capable of considerable expansion during gestation. The upper portion was dilated and thin, and a probe could be passed to near one of the ova. The lower portion of the rectum is so large and so capable of distension as to admit of the periodical inclusion of the young animal, in case its great size should possibly be provided for that purpose, as it is a receptacle large enough for a young animal twice the size of that found now with the mother. The foetal young may possibly have been extruded prematurely after the capture of the animal. We found no cicatrix of an umbilical cord on the abdomen of the young animal.

"A rough sketch of the young as seen by us is appended (fig. 1). It was of a pale colour\*; no apertures for the eyes were yet visible in the skin, nor were any tegumentary appendages formed. The finder contends that he saw the young external to the mother and alive. We purposely abstained from the internal examination of the young one, so as not to mutilate the only specimen available. The four mammary glands at this time are apparently quite rudimentary; they are destitute of nipples, as are those of the Ornithorhynchus. Nor was there the least appearance of milk in these glands. From the imperfect means of judging we had, we incline to the opinion that the Echidna cannot be oviparous.

Fig. 1.



(Signed) "JAMES T. RUDALL.  
"FERD. MUELLER."

"Melbourne, August 25, 1864."

On receiving the specimens I proceeded to examine the female Echidna, and was gratified by finding unmistakeable evidences of marsupial structure. On each side of the abdominal integument, about two inches in advance of the cloaca, and about three inches and a half from the base of the tail, there was a semilunar pouch, with an aperture longitudinal and directed towards the median line, half an inch in depth and two-thirds of an inch in length of aperture, forming a symmetrical pair with their orifices opposite each other (Plate XXXIX. *a*, *b*).

These pouches were not at first apparent, being concealed by the hair which covers the under part of the body. It was in turning over this hair in quest of any rudiment of nipple, that I came, to my surprise, upon one of the pouches. The first doubt was whether it might have been produced by an accidental pressure of the end of a thumb or finger in the previous dissection of the animal, which depression had afterwards got hardened in the spirit; and to solve that doubt I proceeded to examine the opposite half

\* "Said originally to be bright red.—F. M."

of the ventral integument, when a pouch or inverted fold of precisely similar shape, depth, and dimensions appeared, but with the opening turned the opposite way; the folds were closer and less conspicuous on that side, the cavity of the pouch being flatter (see section, Plate XL. fig. 3), whence I inferred that the more open pouch (*ib.* section, fig. 2, *c*) had been the seat or nest of the very small and probably recently-born animal, whose position there, as in the figure, Plate XXXIX. *a*, had naturally led the original captor of the Echidna to conclude that it was hanging by a nipple.

No such projection, however, presented itself in any part of the inner surface of either pouch; but at the fundus of each was an "areola" or elliptic surface, about four lines in diameter (Plate XL. fig. 4), on which, with the pocket lens, could be discerned the orifices of about fifty ducts of a gland. The canals or roots of fine scattered hairs and several minute white papillæ (*ib.* fig. 5, *p, p*, magn.), about one or two lines apart, on which opened sebaceous follicles, were all the appearances characterizing the otherwise smooth and even surface of these inflexions of the abdominal integument.

The contrast which this pouch presents with that of a true marsupial quadruped containing the mammary foetus\* is great; for even in the uniparous species, *e. g.*, the larger Kangaroos, two, if not four, long slender nipples are conspicuous, to one of which the foetus hangs, closely embracing the pendulous extremity of the nipple by its small, round, terminal, tubular mouth.

My next step was to test the statement in reference to the number and condition of the mammary glands.

I found, as in a former dissection of a younger unimpregnated female Echidna†, that these glands were two in number, forming, like the pouches, a symmetrical pair (Plate XL. fig. 1). Each gland (*a, a'*) was of a flattened, subelliptic form; the left (*a*) being 1 inch 10½ lines, the right (*a'*) 1 inch 8½ lines in long diameter, the left 1 inch 5 lines, the right 1 inch 3 lines in short diameter across the middle, and both glands about 5 lines in thickness at the middle part (figs. 2, 3). Each gland consists of about 100 long, narrow, flattened lobes, obtusely rounded at their free ends, and beginning, at about half-way towards the opposite side, to contract gradually to the duct which penetrates the corium (Plate XL. figs. 2 & 3, *b*), to terminate on the mammary areola (*ib.* *c*) at the fundus of the pouch. From the small size of the areola compared with that of the gland, the lobules have a convergent arrangement thereto, each terminating in its own duct, without blending with the substance of a contiguous lobe; and, as a general rule, without anastomosis of contiguous ducts to form a common canal. Each gland is enclosed in a loose capsule of cellular tissue (fig. 1, *e, e*) and lies between a thick "panniculus carnosus" (figs. 1, 2, 3, *d, d'*), adherent to the abdominal integument (*f, f'*) and the "obliquus externus abdominis" muscle, on a plane exterior or "lateral" to the pouch. The glands had not been exposed or disturbed by any dissection in the preliminary examina-

\* For the signification of this term see "On the Generation of the Marsupial Animals," Philosophical Transactions, vol. cxxiv. p. 333.

† "On the Mammary Glands of the *Ornithorhynchus*," Phil. Trans., *tom. cit.* p. 537, Pl. XVII. figs. 2 & 3.

tion of the animal at Melbourne. The lobules of each gland converge toward the mesial line, in their course to terminate in the fundus of the pouch. Each lobe is a solid parenchymatous body; the duct is more directly continued from a canal which may be traced about halfway toward the fundus of the lobule; the canal gives off numerous short branches from its circumference, which subdivide and terminate in clusters of sub-spherical "acini" or secreting cellules. The structure is on the same general plan as that of the mammary glands in higher mammals, but the cellules are proportionally larger; it closely resembles the structure of the lobes of the same glands in the *Ornithorhynchus*, and in neither Monotreme can the elongated lobes be properly termed "pyriform cæcal pouches."

The converging termination of the lacteal ducts at the fundus of a pouch, or inverted fold of the skin, resembles the disposition of those parts in the *Cetacea*; save that here the ducts terminate on a prominence or nipple projecting from the fundus of the pouch into its cavity; whilst in the *Echidna* they terminate in the smooth and even concave surface of the fundus of the pouch.

Calling to mind Mr. MORGAN'S observation of the concealed nipple in an inverted sac of the tegument at the fundus of the pouch in the young or non-breeding Kangaroo, where, instead of a nipple, there was seen only "a minute circular aperture, resembling in appearance the mouth of a follicle" \*, I made sections of both the marsupial or mammary pouches and glands (Plate XL. figs. 2 & 3) satisfactorily demonstrating that no inverted or concealed nipple or any rudiment or beginning of such existed; and, indeed, had any such arrangement like that of the Kangaroo been characteristic of the mammary organization of the *Echidna*, the glands being functionally active and well developed in the female dissected, such nipple would have been everted, and would have served, as the first observer of the young animal in the pouch believed, to have attached and suspended it to the parent.

But it is evident that the young simply nestles itself within the marsupial fossa, clinging, it may be, by its precocious claws to the skin or hairs of that part, and imbibing by its broad, slit-shaped mouth the nutritious secretion as it is pressed by the muscles acting upon the gland from the areolar outlets of the ducts.

The skin of the abdomen, where it begins to be inverted, loses thickness, and at the fundus of the pouch (ib. fig. 1, *b*, fig. 3, *c*) is only half as thick as where it overspreads the abdomen (ib. fig. 1, *f*). This modification, and the relation of the pouches to the mammary glands, prove the structures shown in Plate XXXIX. *a*, *b*, and Plate XL. figs. 2 & 3, *c*, to be natural, not accidental.

The pair of lateral folds or clefts into the bottom of which the lacteal ducts open, in the *Echidna* are homologous with those similarly related to the mammary glands in Cetaceans, and also to the more developed folds or pouches in Marsupials. In Cetaceans the pair of tegumentary clefts have exclusive functional relations to the mammary organ; in Marsupials the superadded office of receiving and protecting the young

\* "A Description of the Mammary Organs of the Kangaroo," Linn. Trans., vol. xvi. p. 62, pl. 2. fig. 1, *b*.

is associated with so great a development of the inverted tegumentary fold, as to make the mammary relation seem a very subordinate and reduced one. But in the Marsupial series there is a gradation; and both in *Thylacinus* and in the small dorsigerous Opossums of South America (*Didelphys dorsigera*, *D. murina*, *D. pusilla*, &c.), the marsupial structure, if shown at all, is represented by a pair of shallow semilunar fossæ, with their concave outlets opposite to each other, as in *Echidna*.

In this comparison the distinctive peculiarity of the parts in the terrestrial Monotreme is the absence of a teat, or of any rudiment of such: no part of the fundus of the pouch is again everted, produced, or folded about the terminal ducts of the mammary gland, so as to form a pedicle by which the young could take hold with the mouth, and so suspend itself and suck.

The question remains, whether the marsupial pouches of the *Echidna* increase with the growth of the young? It is certain that they commence with the growth or enlargement of the mammary glands preliminary to birth.

In that young specimen of female *Echidna* in which the glands were first discovered\*, their ducts opened upon a plane surface of the abdominal integument. In a nearly full-grown unimpregnated female, preserved in spirits, which I examined and compared with the breeding mother here described, there is also a total absence of inflected folds of the integument where the mammary ducts terminate.

Some movement, perhaps, of these ducts in connexion with the enlargement of the mammary lobes, under the stimulus of preparation for a coming offspring, may, with associated growth of the abdominal integument surrounding the areola, be amongst the physical causes of the first formation of the pouch.

It has already been remarked that the integument of the pouch, especially as it approaches the fundus, is thinner than that covering the abdominal surface of the body, from which the pouch is continued. Such tegumentary growth, continued with the pressure of the part of the growing young within, may lead to a marked increase of size; to be reduced, perhaps, by absorption and shrinking of the skin concomitantly with reduction of the mammary glands after the term of lactation has expired. I much doubt, however, whether the increase of size of the pouch would ever be such as to include and wholly conceal the young animal; it more probably, at the later period of lactation, serves only to admit the head or beak. Thus the ordinary condition of sucking would be reversed in these Australian Mammals; instead of the excretory ducts on an everted process of integument being taken into the mouth, this is received into an inverted pouch into which the milk is poured.

I have not hitherto met with any trace or beginning of such abdominal pouches in the various *Ornithorhynchi* in which I have had occasion to note different phases of the development of the ovaria and mammary glands†.

\* Philosophical Transactions, 1832, p. 537, Pl. XVII. figs. 2 & 3.

† "On the Mammary Glands of the *Ornithorhynchus paradoxus*," Philosophical Transactions, 1832, p. 517. Pl. XV.-XVIII.

A warm-blooded air-breather, compelled to seek its food in water, could not safely carry the progeny it had brought forth in a pocket beneath its body during such quest; and all observers have noted the nest-making instinct of the *Platypus*, in which temporary and extraneous structures only the young have hitherto been found \*. Mr. GEORGE BENNETT states that the nest "appears to be found about the time of bringing forth the young, and consists merely of dried grass, weeds, &c." †

Whether the Echidna prepares any extraneous nest is not known. The specimen transmitted to me by Dr. MUELLER was caught in the hollow of a prostrate "cotton tree." Being a terrestrial animal, she can carry her young about habitually concealed or partly sheltered in her pouches; and the present observations show the nearer affinity in this respect of the Echidna to the marsupial *Lyencephala*. The Echidna may further manifest this relationship by the more minute size of the young when born and transferred to the pouch, as compared with the Ornithorhynchus; but the size of the new-born or newly-excluded young of that monotreme is unknown. The smallest specimen of a young Ornithorhynchus which I have yet seen is that (Plate XLI. fig. 5) to which allusion has been already made as being about two inches in length in a straight line.

The following are the comparative dimensions of this, and of the young of the female Echidna (ib. fig. 3 (magn.), Plate XL. figs. 6–10 (nat. size)), the subject of the present communication:—

	Young Ornithorhynchus.		Young Echidna.	
	in. lin.		in. lin.	
Length from the end of the upper jaw, over the curve of the back, to the end of the tail . . . . .	3	9	1	10
Length from the same points in a straight line along the abdomen . . . . .	2	1	1	1
Greatest circumference of the body . . . . .	2	9	1	0 ‡
Length of the head . . . . .	0	8½	0	4
Length of the upper mandible from the gape . . . . .	0	3	0	1½
Breadth of the upper mandible at the base . . . . .	0	4	0	1
Length of the tail from the vent . . . . .	0	4½	0	1
Breadth of tail at the root . . . . .	0	4	0	½
Length of the fore foot . . . . .	0	3	0	2
Breadth of ditto . . . . .	0	3½	0	1½
Length of the hind foot . . . . .	0	4	0	1
Breadth of ditto . . . . .	0	3	0	2⅓

The circumstances under which this young Echidna was obtained are given in a letter by the captor, Mr. G. O. HARRIS, to Dr. MUELLER, dated "Colac Forest, August 31, 1864."

\* *Tom. cit.* p. 533.

† *Trans. Zool. Soc.* vol. i. pp. 247 & 253.

‡ This might have been more before the body had become somewhat dried, or shrunk in parts.



It appears that Mr. HARRIS, being in Colac Forest, Victoria, on the 12th of August, 1864, his attention was attracted by his dogs to a fallen tree, in the hollow of which the *Echidna* had taken refuge. "On examining her I found the young one attached to one teat, presenting the appearance of a miniature Porcupine\*, with an absence of quills, partially transparent, of a bright red colour." The mother was placed in a porter-cask with earth containing ants.

"On Wednesday the 17th of August it still remained attached to the teat, presenting the same appearance as when first captured, evidently in a living state. I avoided handling it more than necessary, as it evinced signs of terror by a protrusion of the vagina and frequently emitting urine.

"On Thursday, 18th of August, I emptied the earth out of the cask, to replace it with fresh earth containing ants, and to my surprise found the young one removed from the teat. I 'panned off' the earth, as for gold, and found the young considerably shrunk."

Mr. HARRIS thereupon placed it in a bottle of spirits, and transmitted it, with the mother alive, to Dr. MUELLER, Botanic Gardens, Melbourne. Mr. HARRIS concludes his letter by stating, "My dates are correct, as I keep a diary, and you may rely upon what I have stated being authentic."

The condition in which the young *Echidna* has reached me accords with the above account. It is naked, devoid of prickles, the integument thin, but with its transparency affected by the action of the alcohol, and somewhat wrinkled from contractions of the tissues through the same action. The new-born Kangaroo, of similar size and condition, described in the Philosophical Transactions for 1834, p. 344, Plate VII. fig. 5, was also red, like an earthworm, "resembling it not only in colour, but in the semi-transparency of the integument." Mr. HARRIS's observation of the young *Echidna* closely accords in this character with my own on the new-born living Kangaroo. Mr. HARRIS observed the young *Echidna* attached to the mother, and he concluded from analogy that the mode of attachment was as in the other land-quadrupeds of the colony and in mammalia generally; whereas it was kept *in situ* by the duplicature of the skin, and by clinging with the precociously-developed claws of the fore feet to the interior of the pouch. There was most assuredly no nipple: in that particular my own scrutiny accords with the results of the examination of the recent animal by Drs. MUELLER and RUDALL. What appearances suggested to them the idea of four quite rudimentary mammary glands I have been unable to discover; the pair of large mammary glands, together with the pouches into which they pour their secretion, had escaped their observation.

The young *Echidna* (Plate XLI. figs. 3 & 4), of which the admeasurements have been given, resembles the young *Ornithorhynchus* (ib. fig. 5) in the general shape and curvature of the body; it also resembles the new-born Kangaroo above cited in the proportions of the limbs to the body, in the inferior size of the hinder pair, in the degree of development of the digits, and in the feeble indication of eyes or eyelids.

\* The name by which the *Echidna* is commonly known to the settlers and gold-seekers of the colony.

But the mouth is proportionally wider, and has the form of a transverse slit (Plate XL. fig. 9, Plate XLI. fig. 4, *n*); it is not circular. Upon the upper lip (ib. fig. 4, *m*), in the mid line between the two nostrils (*a*), is a small protuberance (*e*), corresponding to that in the young of the *Ornithorhynchus paradoxus* (ib. fig. 5, *e*), and wanting the cuticle. The tongue (ib. fig. 4, *l*) is broad and flat, extending to the "rictus oris," but very short in proportion to that of the parent, and of a very different shape.

The traces of ears are less conspicuous than in the young Kangaroo, the conch being little if at all developed in the mature Echidna. The tail is much shorter than in the young Kangaroo, and shows as much proportional size as in the full-grown Echidna, in which it is a mere stump (Plate XXXIX. *c*) concealed by the quills and hair.

The head is proportionally longer and more slender in the marsupial foetus of the Echidna than in that of the Kangaroo, and already, at this early period, foreshows the characteristic elongation and attenuation of that part in the mature animal.

The form of the mouth as a transverse slit, in *Echidna* as in *Ornithorhynchus*, is a good monotrematous character of the young at that period, since in all true or teated marsupials the mouth of the mammary foetus has a peculiar circular and tubular shape.

A scarcely visible linear cicatrix at the middle of the lower part of the abdomen is the sole trace of umbilicus (Plate XL. fig. 9). A bifid, obtuse rudiment of penis or clitoris (Plate XLI. fig. 3, *d*) projects from the fore part of the single urogenital or cloacal aperture, and in advance of the base of the tail-stump (ib. *c*).

The brain, of which the largest part is the mesencephalon, chiefly consisting of a vesicular condition of the optic lobes, has collapsed, leaving a well-defined elliptical fossa of the integument indicative of the widely open "fontanelle" at the upper part of the cranium (Plate XL. fig. 10, Plate XLI. fig. 3, *o*). The skin of the shrunk body shows folds indicative of the originally plump, well-filled abdomen.

The fore limbs (Plate XL. figs. 11 & 12), in their shortness and breadth, foreshow the characteristics of those of the parent, which may be said, indeed, to retain in this respect the embryonic character with superinduced breadth and strength. The digits have already something of the adult proportions, the first or innermost of the five (fig. 12, *i*) being the shortest, the others retaining nearly equal length, but graduating shorter from the third to the fifth. The characteristic disposition of the digits is better marked in the hind limb (ib. figs. 13 & 14), the second (*ii*) already being the strongest and longest, the rest more rapidly shortening to the fifth (*v*) than in the fore leg; the innermost (*i*), agreeably with the law of closer retention of type in the embryo, though the shortest of the five, is less disproportionately so than in the adult.

It thus appears that the exterior characters of the young animal, figured in Plates XL. & XLI., accord with what might be expected, from the correspondingly immature characters in *Macropus* and *Ornithorhynchus*, in the offspring of the species alleged.

In a question of this kind, as the liberal transmitters of the specimens were not themselves the captors or original observers of the young with the mother, every possibility

of error had to be considered. But I know of no pentadactyle ecaudate marsupial animal which could have afforded a mammary or marsupial fœtus with the characters of that which Mr. HARRIS affirms to have discovered attached to the female Echidna, and which he transmits to his correspondents in Melbourne as the young of that monotreme. The condition of the mammary glands, and the presence of heretofore unobserved marsupia, accord moreover with her alleged maternity and with the state of development of her offspring.

It occurred to me that an additional test might be afforded by the more essential parts of the female organs of generation. These had been examined in a general way by Drs. MUELLER and RUDALL, whose "Notes" have been already quoted. I proceeded, therefore, to remove these organs (Plate XLI. fig. 1), with the rectum (*ib. m*), urinary bladder (*r*), urogenital canal (*u*), and cloacal vestibule (*m'*).

The left ovarium (*o*), as in the *Ornithorhynchus paradoxus*, is of an oblong flattened form, developed from the posterior division of the ovarian ligament (*i*) and corresponding wall of the ovarian capsule (*e*); it consists of a rather lax stroma invested by a smooth, thin, firm "tunica propria," which glistens where stretched over the enlarged ovisacs. Of these there were five, of a spherical form, most of them suspended to the rest of the ovarium by a contracted part of the periphery, not stretched into a pedicle. The largest had a diameter of  $1\frac{1}{2}$  line, the least of the five had a diameter of rather less than one line. In the recent state, very fine vessels were spread reticularly, according to the original dissectors, over the ovisacs. Beneath these, or nearer the ovarian ligament, was a cluster of smaller ovisacs, the largest not exceeding  $\frac{1}{3}$ rd of a line, the rest so small as to give a granular character to the part. External to this, at the end of the ovarium nearest the bifurcation of the ligament, was an empty ovisac (*g*),  $2\frac{1}{2}$  lines in length, and 2 lines in diameter, of a flattened pyriform shape, with a somewhat wrinkled exterior, attached by the base, with the apex slightly tumid, and showing a trace of a fine cicatrix. This is a "corpus luteum" or ovisac from which an ovarian ovum had been discharged.

The oviducal branch of the ovarian ligament passes, as in the *Ornithorhynchus*, to the outer angle of the wide oviducal slit or aperture (*e*), which occupies or forms the margin of the ovarian pouch (*c*), opposite to that to which the ovary is attached. The ligament spreads upon the inner wall of the infundibular part of the oviduct, and rejoins the ovarian division of the ligament, to be continued along the oviduct, puckering up its short convolutions into a small compass.

The "fallopian" aperture of the infundibulum (*e*), is a longitudinal slit of 9 lines in length, with a delicate membranous border extending about a line beyond the part where the muscular and mucous tissues of the oviduct make the thin wall of the infundibulum opaque; its transparency against a dark ground, contrasting with the opaque beginning of the proper tunics of the oviduct, which nevertheless are here very thin.

No part of this delicate free margin is produced into fimbriæ; in this respect the

Echidna accords with the Ornithorhynchus, and equally manifests the character by which the Monotremes differ from the Marsupials\*.

The infundibular dilatation suddenly contracts about an inch from the opening into a "fallopian tube," about a line in diameter, which is puckered up into four or five short close coils. The oviduct, after a slight contraction, suddenly expands into the uterus (ib. *d*). This is about 2 inches long, and appears to have been about 6 lines in diameter, before being cut open. It commences by a short well-marked band, convex outwards, and then proceeds nearly straight, the pair converging to the urogenital compartment, slightly contracting at its termination, which projects, as an "os tinæ" (ib. *s'*), into the side of the fundus of that division of the cloaca.

The tunics of the uterus are, externally, the peritoneum (ib. fig. 2, *a*), which is attached by a lax cellulosity to the "tunica propria" (*b*); this, with its fibrous or muscular layer, is thin, not exceeding  $\frac{1}{8}$ th of a line in the present specimen. The inner layer of the uterine wall (*c*) is the thickest, and chiefly composes it, consisting of delicate vascular lamellæ stretched transversely between the fibrous layer and the fine smooth lining membrane (*d*), the whole being of a pulpy consistence, and doubtless in the recent animal highly vascular, especially in the impregnated state.

The lining membrane was thrown into delicate irregular rugæ, which assumed the longitudinal direction at the "cervix" or contracted terminal part of the uterus. It is laid open in the left uterus; a style (*s*) is passed through it in the right uterus.

The orifice in the "os tinæ" was a puckered slit, about a line in extent; below it, on a produced or papillose part of the prominence, was the small circular orifice of the ureter; a fine hair is passed through each of these tubes in fig. 1, *u*, Plate XLI.

The right ovarium (*o'*), was proportionally more developed and larger than in the *Ornithorhynchus paradoxus*: three ovisacs were enlarged and attached to the stroma, as in the left ovarium; and there was also a compressed ovisac (*g*), similar in size and shape to that in the left side, and exhibiting an apical cicatrix; whence it is to be inferred that, in this instance, the right as well as the left ovarium had furnished an impregnated ovum; and the near equality of size and close similarity of structure and condition of the right oviduct and uterus equally evinced that they had participated in the last operations of the season of generation.

Figure 2 gives a magnified view of the structure of the right uterine walls, as seen in transverse section.

The urinary bladder (*r*), opened into the middle of the fundus of the urogenital compartment, as indicated by the stylet (*r*, fig. 1, Plate XLI.), the uterine orifices intervening between the vesicular one and those of the ureters, as in the *Ornithorhynchus paradoxus*.

\* See Philosophical Transactions, 1834, Plate VI. fig. 1—"fimbriæ" of Kangaroo; and art. *Marsupialia*, Cyclop. of Anatomy and Physiology, vol. iii. fig. 137, "fimbriæ" still more remarkably developed in the Wombat (*Phascalomys*). The absence of these fimbriæ, and the resemblance of the true abdominal orifice of the oviduct to that of the ovarian pouch, or to an ordinary duplicature of membrane, appear to have prevented its recognition by Drs. M. and R.

The urogenital canal is 1 inch 4 lines in length, and about 9 lines in diameter: its inner surface shows by some coarse wavy longitudinal rugæ its capacity for dilatation.

The rectum was here of great width; it terminated by a contracted puckered aperture (*m'*), in the back part of the beginning of the vestibule, behind the aperture of communication of the urogenital with the vestibular canal. The distal half of the vestibule is lined by a denser and less vascular epithelium than the proximal one.

I conclude from these appearances that the present *Echidna* had produced two young, of which one only was secured; and that, either, one was left in a nest in the fallen hollow tree, while the other was imbibing milk from the pouch; or that, if she had carried a mammary foetus in each pouch prior to her capture, one had fallen out in the scuffle that drove her from her place of shelter and concealment. The slight difference in size between the right and left mammary glands may relate to the longer continuance of the left one in functional activity, after the loss of the young from the right pouch.

The chief points in the generative economy of the Monotremes which still remain to be determined by actual observation are—

1. The manner of copulation.
2. The season of copulation.
3. The period of gestation.
4. The nature and succession of the temporary structures for the nourishment and respiration of the foetus prior to birth or exclusion.
5. The size, condition, and powers of the young at the time of birth or exclusion.
6. The period during which the young requires the lacteal nourishment.
7. The age at which the animal attains its full size.

In respect to the second point: as Mr. HARRIS caught the female *Echidna* with the young, about an inch in length, on the 12th of August, she may be impregnated at the latter end of June or in July. Females killed in the last week of July and the first week of August, in the Province of Victoria, would be most likely to afford the capital facts noted under the fourth head; viz. the impregnated ovum *in utero* showing some stage of embryonal development in the spiny terrestrial Monotreme. As to the hairy and aquatic *Ornithorhynchus*, the impregnated females in which ova were found in the uterus, of small size, and prior to the formation of the embryo, were caught on the 6th and 7th of October\*. Young *Ornithorhynchi*, measuring in length in a straight line 1 inch and  $\frac{7}{8}$ ths, were found in the nest on the 8th of December. The period of impregnation is, therefore, in this species, in the locality of the Murrumbidgee River, probably the latter end of September or beginning of October. Females captured in the latter half of October and in the month of November, would be most likely to have ova *in utero* exhibiting stages of embryonal development.

On this point I have been favoured with the following letter, one of a kind including most which reach me from Australia on the subject, exciting, instead of allaying, curiosity.

\* See figure of the impregnated specimen in Philosophical Transactions, 1834, Plate XXV. *a*, *a'*.

“Wood’s Point, September, 21st, 1864.

“To Professor R. OWEN,

“SIR,—I have great pleasure in being able to inform you of a very interesting discovery in the economy of the *Ornithorhynchus paradoxus*, and one which I have no doubt you will hail with delight. About ten months ago, a female Platypus was captured in the River Goulburn by some workman who gave it to the Gold-Receiver of this district. He, to prevent its escape, tied a cord to its leg and put it into a gin-case, where it remained during the night. The next morning, when he came to look at it, he found that it had laid two eggs. They were about the size of a crow’s egg, and were white, soft and compressible, being without shell or anything approaching to a calcareous covering.

“I had an opportunity of examining them externally, and I found no evidence of their having had any recent vascular connexion with the maternal organs; but I am sorry to say that I never had a chance of examining their contents, as, on inquiring for them a day or two afterwards, I found they had been thrown away, much to my chagrin and disappointment.

“The animal itself was afterwards killed (next day), and I was told that numerous ova [in the words of my informant ‘eggs’] were found in it, in various stages of development, which in the aggregate somewhat resembled a bunch of grapes; but this I cannot personally vouch for.

“It may appear to you a matter of surprise that I did not examine more minutely this most interesting animal; but I am sorry to say that the same spirit that dictated the throwing away of the eggs, prevented me making a more detailed investigation.

“I am in hopes that I shall be able to get another pregnant specimen, if so, I shall have much pleasure in sending it to you for your inspection.

“I have the honour to be, Sir,

“Your obedient Servant,

“JNO. NICHOLSON, M.D., &c.”

“Wood’s Point, Victoria, Australia.”

By a following mail I was favoured by my esteemed correspondent, Dr. MUELLER, with a letter from the “Gold-Receiver” referred to by Dr. NICHOLSON, in reply to inquiries which vague reports of the occurrence had induced Dr. MUELLER to make.

“Wood’s Point, September 25, 1864.

“DEAR SIR,—In reply to your inquiries relative to the *Ornithorhynchus paradoxus*, I must in the first place correct an erroneous impression which the newspaper paragraph has conveyed.

“The Platypus is not now in my possession, and the eggs were layed the day after its capture. The animal was captured in the Goulburn and given to me. It was then fastened by a cord in a gin-case, and on examining it the next morning the two eggs were found in the bottom of the box, both of them having undoubtedly been laid

during the night. In the course of the day the creature was killed by a *would be* scientific friend of mine, with the intention of preserving its skin; and on opening the body the ovaries were found to be clustered with ova in different stages of growth; but none of them so large as the eggs which were laid. These eggs were white, soft, and without shell, easily compressible, and about the size of a crow's egg.

"Not being sufficiently versed in the subject I am not prepared to say whether these eggs might not have been abortions caused by fear, but there was no appearance on the surface of their ever having been vascularly connected with the maternal uterus, and reviewing all the facts observed I should undoubtedly say that the animal was oviparous.

"I am, dear Sir,

"Yours faithfully,

(Signed) "GEO. J. RUMBY."

Dr. MUELLER, in transmitting me the foregoing copy of the Gold-Receiver's letter, writes (November 25th, 1864), "Since writing to you by last mail I have received the enclosed letter respecting the *Ornithorhynchus* having proved to be '*oviparous*.' How are all these statements to be reconciled?"

Assuming the fact of the oviposition, in the month of December 1863 (Dr. NICHOLSON writes of the occurrence as having happened "about ten months" before the date of his letter, September 21, 1864) by a female *Ornithorhynchus*, of two ova, about the size of a crow's egg, "white, soft, compressible, without shell or anything approaching to a calcareous covering," the question is—What did they contain? Had the unvascular chorion been cut or torn open, an embryo or a yelk might have been seen. Better still would it have been if both ova had been at once immersed in a bottle of whatever colourless alcoholic liquor might be at hand. Probably no medical man had ever an opportunity or a chance of settling a point in Comparative Physiology of more interest, and with less trouble, than the gentleman who was privileged to be the first person to see and handle the new-laid eggs of the *Ornithorhynchus paradoxus*.

For the reasons given in my Memoir of 1834\*, I concluded that the Monotremes were not "oviparous" in the sense of the author of the memoir in the '*Annales des Sciences Naturelles*,' vol. xviii. (1829)†, but that they were ovo-viviparous, and in a way or degree more nearly resembling the generation of the Viper and Salamander than occurs in the *Marsupialia*.

The young Viper is provided with a specially and temporarily developed premaxillary tooth for lacerating the soft, but tough, shell of its egg, and so liberating itself‡. From this analogy I imagine that the young Monotremes may be provided with a horny or epidermal process or spine upon the internasal tubercle, for the same purpose. This temporary tubercle is obviously homologous with the hard knob on the upper mandible

\* "On the Ova of the *Ornithorhynchus paradoxus*," Philosophical Transactions, vol. cxxiv. p. 555.

† R. E. GRANT, "Œufs de l'*Ornithorhynque*," Ann. des Sciences Nat. 1829.

‡ WEINLAND, in MÜLLER'S Archiv für Physiologie, 1841.

of chelonians and birds, by which they break their way through the harder calcareous covering of their externally hatched embryo.

Some modification of epiderm has been removed from the tubercle in the young *Echidna* (Plate XLI. fig. 11, *e*), as in the young *Ornithorhynchus*\*.

#### DESCRIPTION OF THE PLATES.

#### PLATE XXXIX.

Female *Echidna* (*Echidna Hystrix*, Cuv.), two-thirds nat. size.

- a.* Left "Marsupial" or "Mammary" pouch, with young as seen therein.
- b.* Right ditto empty.
- c.* Tail-stump of *Echidna*.
- d.* Outlet of cloacal vestibule.
- e.* Young or "mammary fœtus," as removed from the pouch; two-thirds nat. size.

#### PLATE XL.

- Fig. 1. Section of abdominal integument, with mammary glands of the *Echidna* exposed from the inner side.
  - a.* Left mammary gland; *a'*. Right mammary gland.
  - b.* Ducts converging to fundus of mammary pouch.
  - d, d'*. Part of "panniculus carnosus" acting as compressor of the gland.
  - e.* Fascia forming a capsule of the gland, reflected.
  - f.* Skin of abdomen.
- Fig. 2. Section of abdominal integument, and left mammary gland and pouch.
- Fig. 3. Section of abdominal integument, and right mammary gland and pouch.
  - c.* Cavity of pouch; the other letters as in figure 1.
- Fig. 4. Orifice of mammary pouch, expanded to expose the mammary areola.
- Fig. 5. Mammary areola magnified to show the orifices of the lacteal ducts, and *p*, sebaceous papillæ.
- Fig. 6. Young or "mammary fœtus" of *Echidna Hystrix*: nat. size: side view.
- Fig. 7. Ditto: front view.
- Fig. 8. Ditto: back view.
- Fig. 9. Ditto: under view.
- Fig. 10. Ditto: upper view.
- Figs. 11 & 12. Ditto: fore-foot magnified.
- Figs. 13 & 14. Ditto: hind-foot magnified.

\* Transactions of the Zoological Society, vol. i. pl. xxxiii. fig. 8.



## PLATE XLI.

- Fig. 1. Female organs of *Echidna Hystrix*; letters explained in the text.
- Fig. 2. Section of uterus: magnified; ditto.
- Fig. 3. Young of *Echidna Hystrix*: twice nat. size; ditto.
- Fig. 4. Ditto: mouth and end of upper jaw: five times nat. size:—*a*, nostril; *e*, internarial tubercle; *m*, upper lip; *n*, lower lip; *l*, tip of tongue.
- Fig. 5. Young of *Ornithorhynchus paradoxus*:—*a*, nostril; *b*, eye-orifice; *c*, ear-orifice; *e*, internarial tubercle; relatively smaller than in fig. 3, as being in progress of disappearance in a more advanced young one.



Fig. 1.

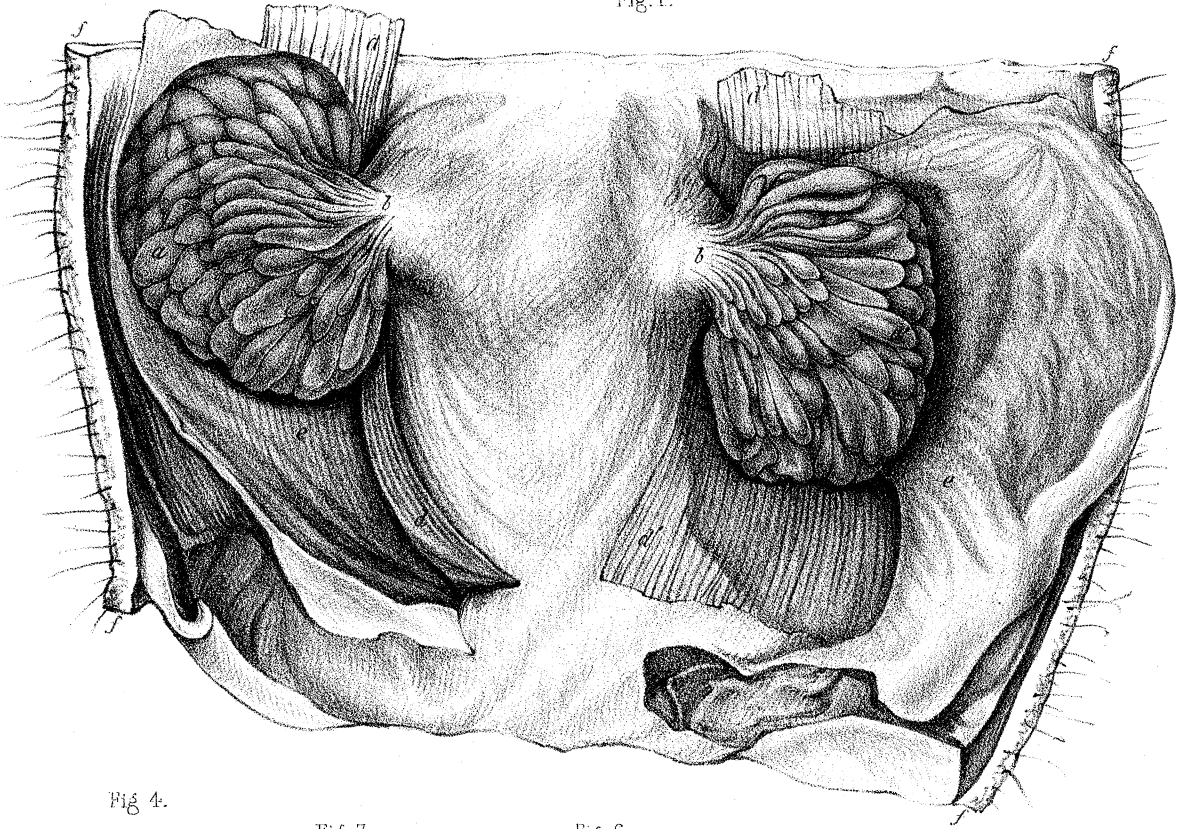


Fig. 4.



Fig. 7.



Fig. 6.

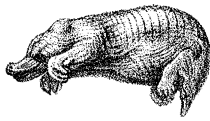


Fig. 8.



Fig. 5.

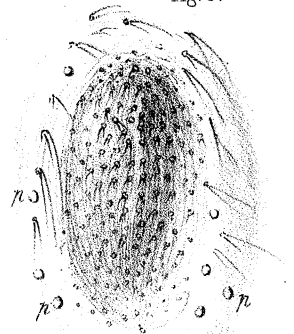


Fig. 9.



Fig. 10.



Fig. 2.

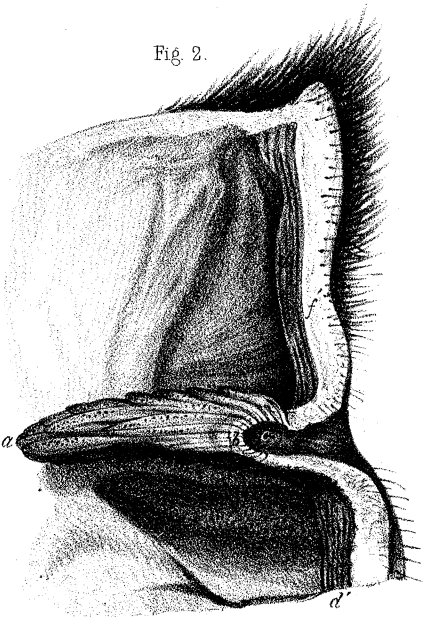


Fig. 11.



Fig. 12.



Fig. 13.



Fig. 14.



Fig. 3.

